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DRAWINGS ATTACHED

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(54) DEVICE FOR DRAWING AND/OR REDUCING AND TRIMMING HOLLOW BODIES

(71) We, RASSELSTEIN AKTIENGESELLSCHAFT, a Body Corporate organised and existing under the laws of the Federal Republic of Germany, of 545 Neuwied/Rhein, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a device for drawing and/or reducing, and trimming hollow bodies, more particularly cylindrical hollow bodies, in which reduction is effected by means of a reducing punch and a reducing ring having a working surface.

In both the deep drawing and subsequent reduction of sheet-metal hollow bodies, irregular edge boundaries are formed on such bodies, being caused, on the one hand, by the shaping operation and, on the other hand, by the properties of the material. This irregular edge prevents further machining of the hollow bodies, which may be for example cylindrical cups. The further machining may consist, for example, in flanging of the edge. Trimming of the edge is therefore necessary.

According to the invention there is provided a device for drawing and/or reducing, and trimming hollow bodies, in which reduction is effected by means of a reducing punch and a reducing ring having a working surface, the reducing punch having a collar with a cutting edge at a distance from its leading end corresponding to the desired height of the finally reduced hollow body, the diameter of the cutting edge being such compared with the internal diameter of the reducing ring at part of the working surface that, during the reducing operation, the reduction capacity of the material of the hollow body is exceeded at the cutting edge and the material ruptures at the said edge, the punch being encircled by an annular groove arranged between the cutting edge and the said end of the punch.

By means of such a device the working operation of trimming the hollow body is shifted directly to the end of the reducing operation. As soon as the hollow body has reached its desired height during reduction, on further advance of the reducing punch in the reducing ring, trimming of the edge of the hollow body occurs, owing to the reduction capacity of the material of the hollow body being locally exceeded at the cutting edge. The material ruptures at this place. Both the reduction and trimming of the hollow body are accordingly accomplished by one and the same movement of the reducing punch.

The invention will now be described in more detail, by way of example, with reference to the accompanying drawing, in which:

Figure 1 shows a device embodying the invention for reducing and trimming hollow bodies consisting of a reducing ring, represented in section, and a reducing punch;

Figure 2 shows in section a hollow body made and trimmed by means of the device of Figure 1; and

Figure 3 shows the edge part cut off the hollow body of Figure 2, by means of the device of Figure 1.

In Figure 1, at 1 is shown a reducing ring and at 2a the corresponding reducing punch. The reducing ring 1 has a working surface 3, comprising a frusto-conical entry part 4 with the cone angle α, and a cylindrical principal part 5 with the diameter d_1. In reducing a previously already deep-drawn hollow body, during which the reducing punch 2a of the reducing tool forces the said hollow body along the working surface 3 of the reducing ring through the said reducing ring in the direction of the arrow A, the wall thickness of the deep-drawn hollow body is reduced to the value denoted by S in Figure 2 owing to the pressure between the work-

ing surface 3 of the reducing ring 1 and the reducing punch 2a, which also has a working surface, denoted by 6. The diameter of the reducing punch 2a in the region of the working surface 6 is denoted by d_0. The relationship $S=\frac{1}{2}.(di-d_0)$ applies.

Simultaneously with the reduction in wall thickness, the hollow body naturally increases in length.

At a distance from its end corresponding to the desired height of the finally reduced hollow body 7a, the reducing punch 2a has a collar 8 with a cutting edge 9. The diameter d_2 of the said cutting edge 9 is such that during the reducing process, that is to say while a deep-drawn hollow body is being pushed through the reducing ring 1 by means of the reducing punch 2a, the reducing capacity of the material is exceeded at the cutting edge 9 and the material ruptures at this cutting edge. On the further advance of the reducing punch 2a, the severed edge part 10a, shown in Figure 3, then remains behind, while the finally reduced and trimmed hollow body 7a is ejected from the reducing ring 1 at the opposite side 11 of the said ring.

As will be seen from Figure 1, in this embodiment example, the diameter d_2 of the cutting edge 9 is slightly greater than the diameter d_0 of the punch 2a at its working surface 6. The relation between the diameters d_2 and d_0 depends on the thickness of the material to be reduced. In the case of small wall thicknesses of this material, the said difference is usually small or zero.

It is advantageous to make the surface of the punch rough between its end 12 and the cutting edge 9, but to make the surface polished after the cutting edge. Strain on the material on the polished surface 13 is thereby increased and assists in the rupturing process.

An annular groove 15 encircles the punch 2a between the cutting edge 9 and the end 12 of the punch, and the annular base 14 of the said groove is at a distance from the cylindrical part 5 of the working surface 3 of the reducing ring 1 when, during reduction, the base 14 is aligned with the part 5, corresponding to at least the thickness S of the not yet reduced hollow body. This annular groove 15, machined in the punch 2a, consequently permits the edge portion 16 of the hollow body 7a to be thicker than the rest of the body, reduced and trimmed by means of the device. This thickened portion having the thickness S′, is of advantage in the subsequent machining of the finished hollow body 7a, for example it provides greater certainty in flanging. In the groove 15, the material is not subjected to any reduction at all and therefore retains its original wall thickness whereby the reduction ratio is greatly increased on the engagement of the sharp cutting edge 9 allowing a gap width between punch and reducing ring of only $\frac{1}{2}(d_1-d_2)$. This also assists the rupturing of the edge part 10a.

In the embodiment example described, the distance of the annular base 14 of the groove from the part 5 of the working surface 3 of the reducing ring 1, when during reduction, the base 14 is aligned with the part 5, corresponds at least to the thickness of the material of the not yet reduced hollow body. As already stated, no reduction of the material therefore occurs in the region of the groove 15. The groove 15, however, may also be made shallower so that in its region, a slight reduction occurs in the material of the hollow body; the thickness of the edge 16 is then of course less than as shown.

The dimensions of a device of the type illustrated are given in the following by way of example. In this device, the diameter d_1 of the cylindrical part 5 of the working surface 3 of the reducing ring 1 is 65.4 mm. As diameter d_0 of the reducing punch 2a in the range of its working surface 65.0 mm was selected, and as diameter d_2 of the cutting edge 9, 65.2 mm was selected. The diameter d_3 of the punch in the region of the groove 15 is 64.8 mm.

With this device, a drawn cup having a mean initial wall thickness of 0.3 mm was reduced to a wall thickness of S=0.2 mm. In the groove 15, the wall thickness of 0.3 mm was retained. At the cutting edge 9 where the metal sheet had only a gap width of 0.1 mm available, the reduction ratio was consequently about 65% which exceeded the reduction capacity of the sheet metal material. Rupture therefore occurred at this place. The diameter d_2 of the cutting edge 9, in the example given could, if necessary, be reduced to that of the reducing punch, namely 65.0 mm. In such a case, in particular, it is advantageous as already stated to make the surface of the punch 2a rough between its end 12 and the cutting edge 9, but to make the surface polished after the edge.

In addition, it is also stated that the cone angle α of the frusto-conical part 4 of the reducing surface 3 of the reducing ring 1 is designed to be advantageous for the reduction of a hollow body, independently of trimming; it is for example 10°.

It is pointed out that the drawing and reducing of a hollow body need not absolutely represent two independent working operations. On the contrary, it is possible for example to arrange a drawing ring and a reducing ring one after the other or to use a single ring for drawing and/or reducing and subsequent trimming. If, for example, instead of the sharp edge 17 at the entry of the reducing ring 1, a rounded edge is provided, then deep-drawn, reduced and trimmed hollow bodies may be made in one working operation.

WHAT WE CLAIM IS:—

1. A device for drawing and/or reducing, and trimming hollow bodies, in which reduction is effected by means of a reducing punch and a reducing ring having a working surface, the reducing punch having a collar with a cutting edge at a distance from its leading end corresponding to the desired height of the finally reduced hollow body, the diameter of the cutting edge being such compared with the internal diameter of the reducing ring at a part of the working surface that, during the reducing operation, the reduction capacity of the material of the hollow body is exceeded at the cutting edge and the material ruptures at the said edge, the punch being encircled by an annular groove arranged between the cutting edge and the said end of the punch.

2. A device according to claim 1, in which the diameter of the cutting edge is substantially the same as the diameter of the surface of the punch between said end and the edge of the groove nearer thereto.

3. A device according to claim 1 or 2, in which the surface of the punch is roughened between its leading end and the cutting edge, but is polished after the cutting edge.

4. A device for drawing and/or reducing, and trimming hollow bodies, constructed and arranged substantially as herein described with reference to and as shown in the accompanying drawing.

5. A device according to any of the preceding claims in which the annular base of the groove is at a distance from a cylindrical portion of the working surface of the reducing ring when the base and the cylindrical portion are aligned which corresponds at least to the thickness of the material of a hollow body to be drawn, and/or reduced, and trimmed by the device.

6. A method of using a device according to any of the preceding claims, wherein the dimensions of the device relative to the hollow body to be reduced and trimmed are such that the annular base of the groove is at a distance from a cylindrical portion of the working surface of the reducing ring, when the base and the cylindrical portion are aligned, corresponding at least to the thickness of the material of the hollow body before reduction.

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1229475 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1.

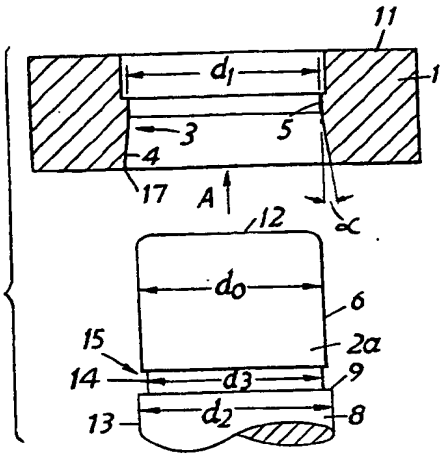

FIG. 2.

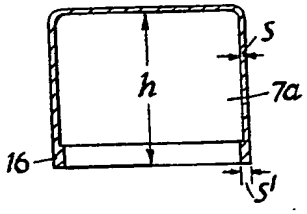

FIG. 3.